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(54) **TEMPERATURE SENSOR AND FRAME CONFIGURATION FOR AN IMAGE FORMING APPARATUS**

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CPC ***G03G 15/5045*** (2013.01); ***G03G 15/2028*** (2013.01); *G03G 2215/0141* (2013.01)

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USPC 399/322, 400
See application file for complete search history.

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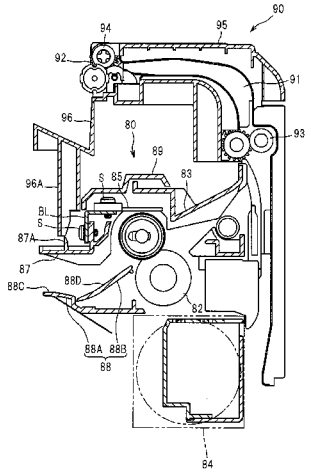
(57) **ABSTRACT**

In an image forming apparatus, a heating member for heating a recording sheet and a pressuring member disposed below the heating member are supported by a fixing unit frame. A noncontact temperature sensor disposed facing the heating member detects a temperature of the heating member without contacting the heating member. An upper frame covers an upper portion of the heating member and an upstream portion of the heating member in a conveying direction of the recording sheet. A plate-shaped upper sheet guide protrudes upstream in the conveying direction from an upstream end of the upper frame and extends in a width direction perpendicular to the conveying direction and to a vertical direction. The upper sheet guide and a lower sheet guide disposed below and facing the upper sheet guide the recording sheet in the conveying direction toward the heating member and the pressuring member.

13 Claims, 5 Drawing Sheets



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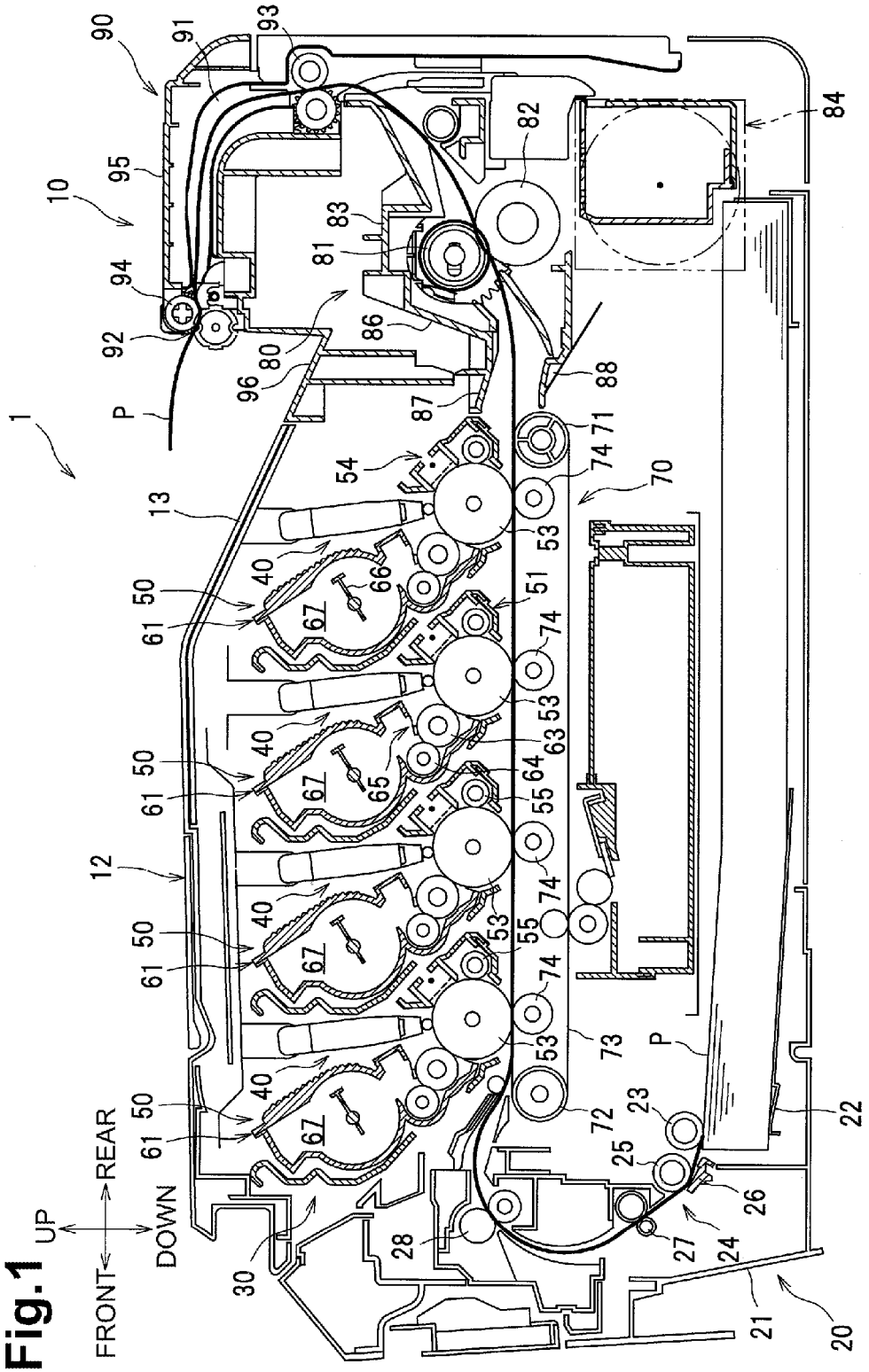
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Fig.1

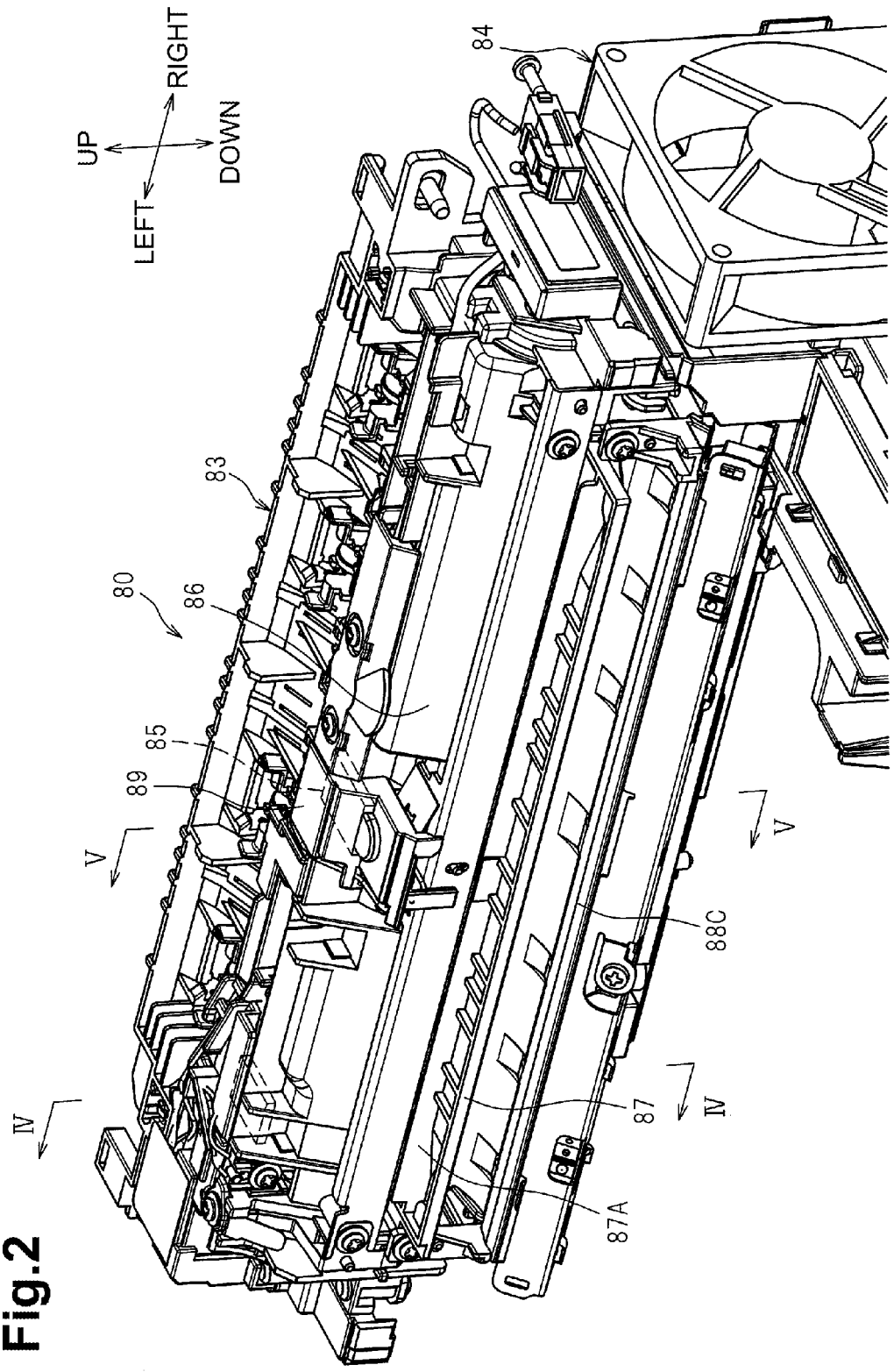


Fig.2

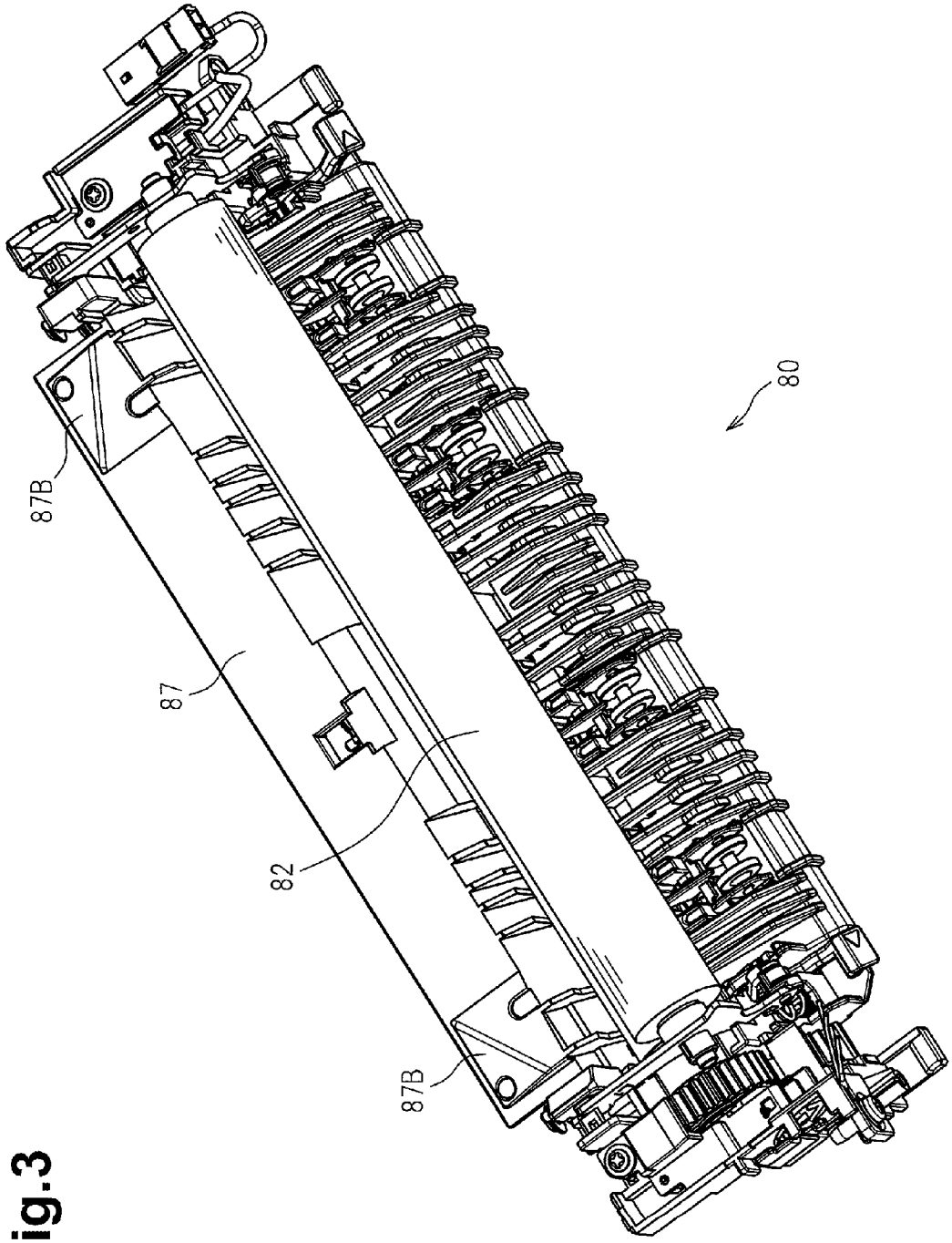


Fig.3

Fig.4

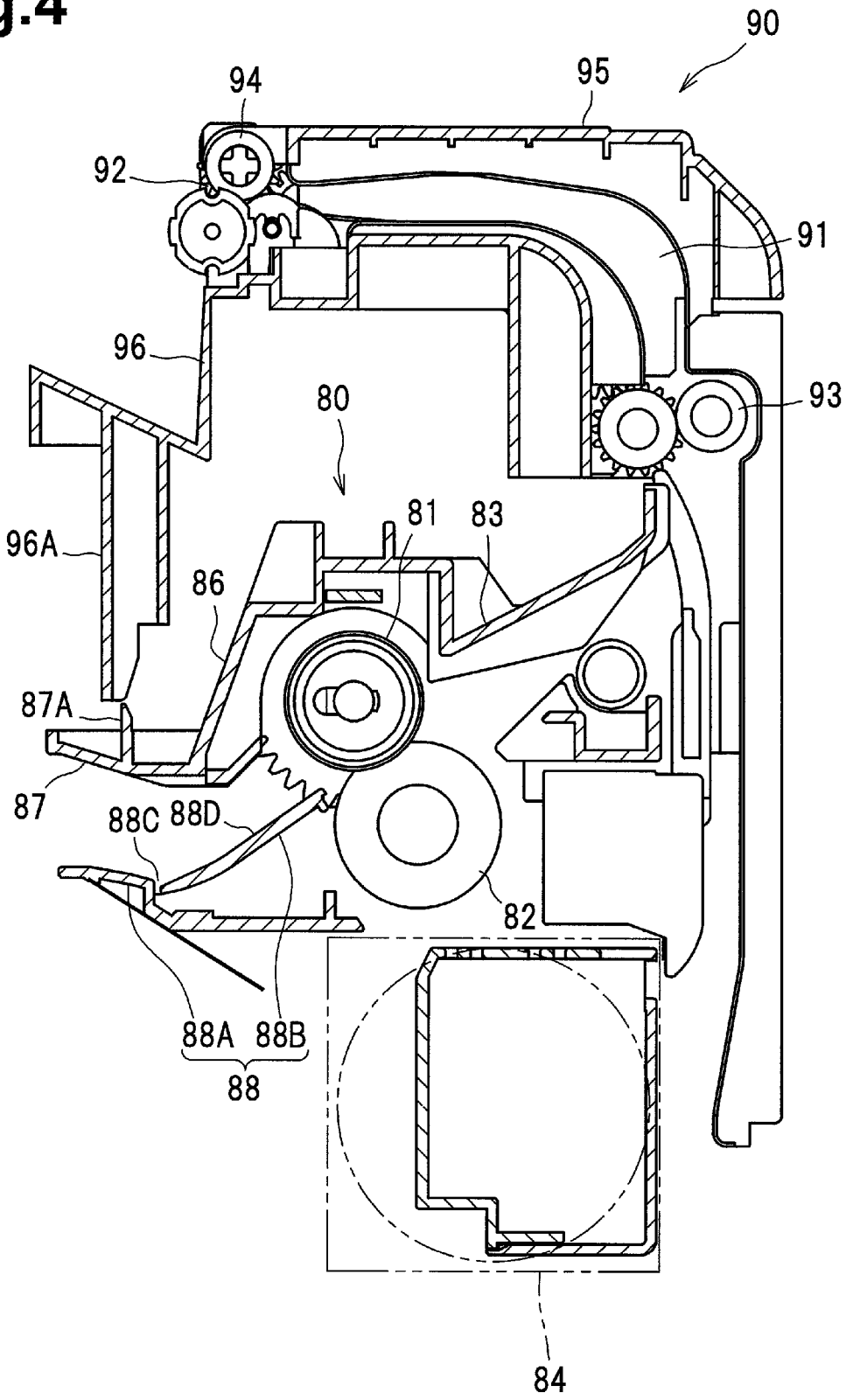
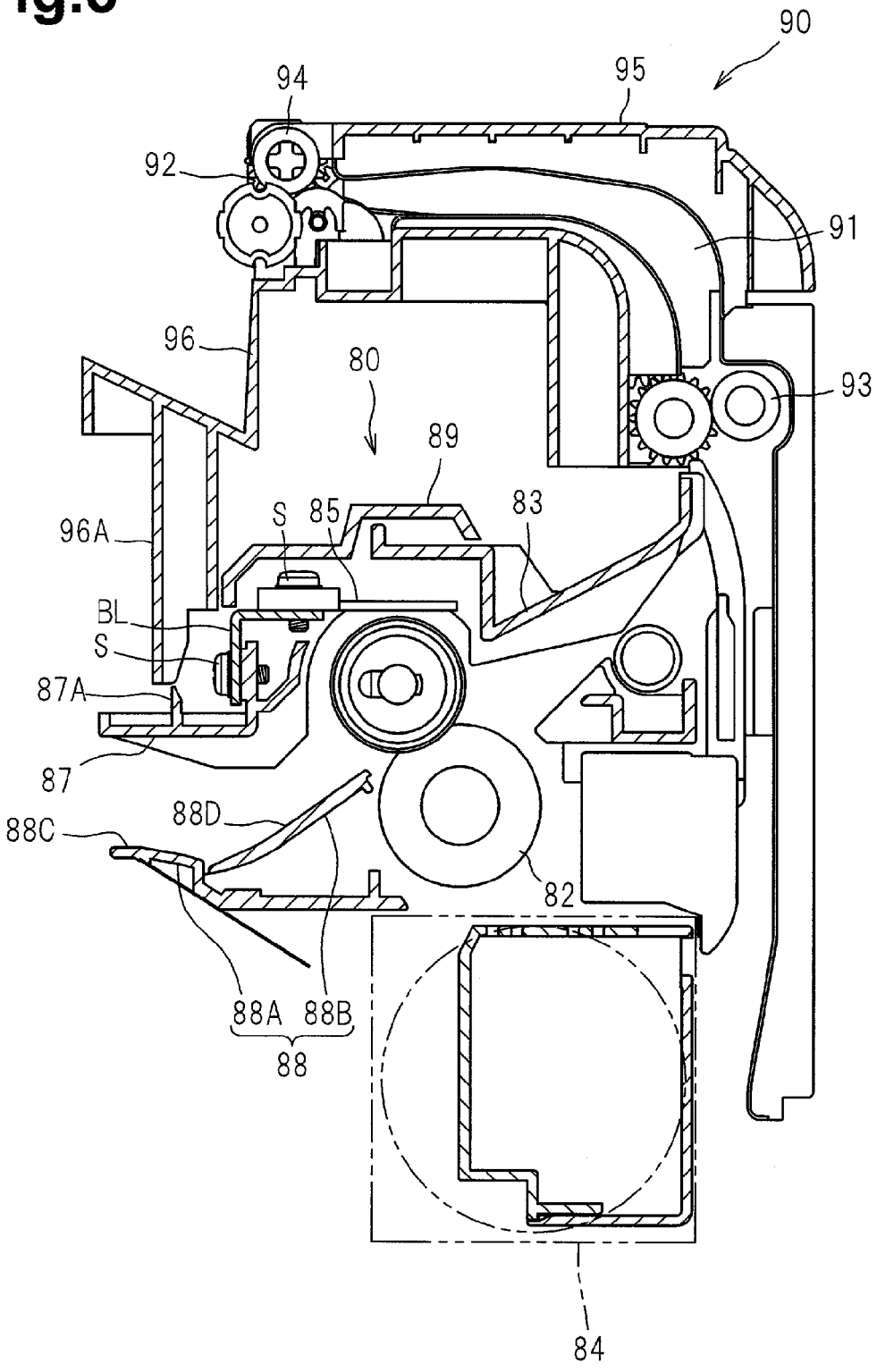


Fig.5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TEMPERATURE SENSOR AND FRAME CONFIGURATION FOR AN IMAGE FORMING APPARATUS

CROSS REFERENCE TO RELATED APPLICATION

This application claims priority from Japanese Patent Application No. 2012-207848, filed on Sep. 21, 2012, the entire disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an image forming apparatus comprising a noncontact temperature sensor configured to detect the temperature of a heating member of a fixing unit without contacting the heating member.

2. Description of Related Art

A known image forming apparatus, e.g., a laser printer and a digital copier, comprises a noncontact temperature sensor, e.g., a noncontact thermistor, configured to detect the temperature of a heating member of a fixing unit.

In such a fixing unit, because the noncontact temperature sensor detects the temperature of the heating member indirectly through an air layer between the noncontact temperature sensor and the heating member, air flow in the air layer, if generated, may prevent the noncontact temperature sensor from detecting the temperature stably. This may result in inaccurate control of the temperature of the heating member.

SUMMARY OF THE INVENTION

Therefore, a need has arisen for an image forming apparatus which allows a noncontact temperature sensor to stably detect the temperature of a heating member of a fixing unit.

According to an embodiment of the invention, an image forming apparatus comprises a heating member configured to heat a recording sheet, a pressuring member disposed below the heating member and configured to press the recording sheet against the heating member, a fixing unit frame supporting the heating member and the pressuring member, a noncontact temperature sensor disposed in the fixing unit frame to face the heating member and configured to detect a temperature of the heating member without contacting the heating member, an upper frame covering an upper portion of the heating member and an upstream portion of the heating member in a conveying direction of the recording sheet, an upper sheet guide which has a plate shape, protrudes upstream in the conveying direction from an upstream end of the upper frame, and extends in a width direction perpendicular to the conveying direction and to a vertical direction, and a lower sheet guide disposed below and facing the upper sheet guide. The upper sheet guide and the lower sheet guide are configured to guide the recording sheet in the conveying direction toward the heating member and the pressuring member.

Other objects, features, and advantages will be apparent to persons of ordinary skill in the art from the following detailed description of the invention and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the invention, the needs satisfied thereby, and the features and technical advantages thereof, reference now is made to the following descriptions taken in connection with the accompanying drawings.

FIG. **1** is a schematic perspective view of an image forming apparatus, e.g., a color printer, according to an embodiment of the invention.

FIG. **2** is a perspective view of a fixing unit shown in FIG. **1**.

FIG. **3** is a perspective view of a lower side of the fixing unit shown in FIG. **2**.

FIG. **4** is an enlarged cross-sectional view of the fixing unit taken along line IV-IV of FIG. **2**.

FIG. **5** is an enlarged cross-sectional view of the fixing unit taken along line V-V of FIG. **2**.

Embodiments of the invention and their features and technical advantages may be understood by referring to FIGS. **1-5**, like numerals being used for like corresponding parts in the various drawings.

In the following description, the expressions "front", "rear", "upper (up)", "lower (down)", "right", and "left" are used to define the various parts when a color printer **1**, is disposed in an orientation in which it is intended to be used.

<General Structure of Color Printer>

As shown in FIG. **1**, the color printer **1** comprises a sheet feed unit **20**, an image forming unit **30**, a fixing unit **80**, a sheet discharge unit **90**, and a main frame **10** accommodating these units. A top cover **12** is disposed at an upper portion of the main frame **10** and configured to pivot about the rear side thereof so as to open and close vertically relative to the main frame.

The sheet feed unit **20** is disposed at the bottom in the main frame **10** and comprises a feed tray **21** for accommodating recording sheets P, a sheet lifting plate **22**, a feed roller **23**, a separation roller **25** disposed along a conveying path **24** of the recording sheet P, a separation pad **26**, a sheet powder removing roller **27**, and a registration roller **28**.

The sheet lifting plate **22** lifts the recording sheets P in the feed tray **21** toward the feed roller **23**, and the feed roller **23** feeds the recording sheets P. The separation roller **25** and the separation pad **26** separate the recording sheets one by one. After the sheet powder removing roller **27** collects a certain amount of sheet powder, the registration roller **28** feeds the recording sheet P to the image forming unit **30**.

The image forming unit **30** comprises four light emitting diode (LED) units, four process cartridges **50**, and a transfer unit **70**. Each process cartridge **50** comprises a photosensitive drum cartridge **51** and a developing cartridge **61** which is removably attached to the photosensitive drum cartridge **51**.

Each LED unit **40** is disposed above a corresponding photosensitive drum **53** and comprises, at a lower end thereof, a plurality of LEDs (light emitting diodes) arrayed in a left-right direction. LEDs of the LED unit **40** turn on and off based on image data to expose the surface of the photosensitive drum **53** to light. The LED units **40** are held by the top cover **12** so as to be separated from the respective photosensitive drums **53** when the top cover **12** is open.

The process cartridges **50** are disposed between the top cover **12** and the feed tray **21** and are arranged along a front-rear direction. The process cartridges **50** are replaceably attached to the main frame **10** when the top cover is open.

Each photosensitive drum cartridge **51** comprises the photosensitive drum **53**, a charger **54**, and a recovery roller **55**. The recovery roller **55** collects toner which has not been transferred and remains on the photosensitive drum **53**.

Each developing cartridge **61** comprises a developing roller **63**, a supply roller **64**, a blade **65**, an agitator **66**, and a storage **67** for storing an developing agent, e.g., a positive charge toner.

A transfer unit **70** is disposed between the feed tray **21** and the process cartridge **50** and comprises a drive roller **71**, a

driven roller **72**, an endless conveying belt **73**, and four transfer rollers **74**. The conveying belt **73** is stretched around the driven roller **71** and the driven roller **72**. An outer face of the conveying belt **73** opposes the arranged photosensitive drums **53**. The transfer rollers **74** are disposed inside the conveying belt such that each transfer roller **74** and the corresponding photosensitive drum **53** nip the conveying belt **73**.

The fixing unit **80** is disposed behind the four process cartridges **50** of the image forming unit **30**. The fixing unit **80** comprises a heating member, e.g., a heat roller **81**, for heating the recording sheet P and a pressuring member, e.g., a pressure roller **82**, for pressing the recording sheet P against the heat roller **81**. The heat roller **81** and the pressure roller **82**, which are main components of the fixing unit **80**, are rotatably supported by the fixing unit frame **83**.

The sheet discharge unit **90** is disposed behind the fixing unit **80**. The sheet discharge unit **90** comprises a convey roller **93**, a discharge roller **94**, and a discharge unit frame **95** which rotatably supports the convey roller **93** and the discharge roller **94**. The convey roller **93** conveys the recording sheet P conveyed from the fixing unit **80** to a discharge port **92** along a discharge path **91**. The discharge roller **94** discharges the recording sheet P from the discharge port **92** onto the discharge tray **13**. The discharge unit frame **95** and an upper cover **96** define the discharge path **91** therebetween.

In the image forming unit **30**, after the charger **54** uniformly and positively charges the surface of the photosensitive drum **53**, the LED unit **40** exposes the surface to light to form an electrostatic latent image, based on image data, on the photosensitive drum **53**. The agitator **66** stirs the toner in the storage **67**, and the supply roller **64** supplies the toner to the developing roller **63** which is applied with a developing bias. The toner enters between the developing roller **63** and a blade **65**, and the developing roller **63** bears a thin layer of toner having a uniform thickness. When the developing roller **63** contacts the photosensitive drum **53**, the toner is supplied from the developing roller **63** to the photosensitive drum **53**. The electrostatic latent image is visualized and a toner image is formed on the photosensitive drum **53**.

Then when the recording sheet P fed to the image forming unit **30** is conveyed between the photosensitive drum **53** and the conveying belt **73**, the toner image formed on the photosensitive drum **53** is transferred onto the recording sheet P. The recording sheet P with the transferred toner image is conveyed to the fixing unit **80**. When the recording sheet P passes between the heat roller **81** and the pressure roller **82**, the toner image is thermally fixed, as an image, onto the recording sheet P. The convey roller **93** and the discharge roller **94** convey the recording sheet P with the image formed thereon along the discharge path **91** and discharge the recording sheet P from the discharge port **92** of the sheet discharging frame **95** onto the discharge tray **13**.

<Detailed Structure of Fixing Unit>

As shown in FIGS. **2** and **3**, the fixing unit **80** comprises a fixing unit frame **83** which is long in a width direction (left-right direction) perpendicular to a conveying direction of the recording sheet P. As shown in FIGS. **4** and **5**, the fixing unit frame **83** rotatably supports the heat roller **81** and the pressure roller **82**, which are main components of the fixing unit **80**.

As shown in FIG. **2**, a single exhaust fan **84** is disposed at a right end of the fixing unit frame **83** to cool the heat roller **81**. A noncontact temperature sensor, e.g., a noncontact thermistor **85**, is disposed at a central portion of the fixing unit frame **83** in the width direction to detect a surface temperature of the heat roller **81** without touching the heat roller **81**.

The heat roller **81** comprises a cylindrical metal tube and a halogen heater (numeral omitted) disposed in the cylindrical metal tube. Opposite ends of the heat roller **81** in an axial direction thereof are rotatably supported by the fixing unit frame **83** through bearings (not shown). The pressure roller **82** is disposed diagonally downward and rearward of the heat roller **81**.

The pressure roller **82** comprises a core bar and a relatively thick urethane rubber layer around the core bar and is configured to apply a predetermined nip pressure to the heat roller **81**. Opposite ends of the pressure roller **82** are supported by an arm (not shown) which is swingably supported by the fixing unit frame **83**. The arm is urged upward by a spring (not shown) such that the pressure roller **82** presses the heat roller **81** with a predetermined force.

As shown in FIG. **4**, the fixing unit frame **83** comprises an upper frame **86**, an upper sheet guide **87**, a lower sheet guide **88**, and a cover portion **89**. The upper frame **86** covers an upper portion and a front portion of the heat roller **81**. The upper sheet guide **87** has a plate shape and extends frontward from a front end of the upper frame **86**. The lower sheet guide **88** is disposed below the upper sheet guide **87** to face the upper sheet guide **87**. The cover portion **89** (FIG. **5**) covers an upper portion of the noncontact thermistor **85**.

As shown in FIG. **2**, the exhaust fan **84** is disposed at a right end of the fixing unit frame **83**. That is, the exhaust fan **84** is disposed at a right end portion of the heat roller **81** in the axial direction. As shown in FIGS. **4** and **5**, the exhaust fan **84** is disposed below and slightly rearward of the heat roller **81**.

In operation, the exhaust fan **84** takes air into the inside of the main frame **10** from the discharge port **92** at an upper portion of the sheet discharge unit **90**, and exhausts the taken air out of a rear right, lower portion of the main frame **10**. Consequently, air flow is generated inside the main frame **10** and the generated air cools the surroundings of the fixing unit **80**.

The noncontact thermistor **85** is a semiconductor device capable to detect a surface temperature of the heat roller **81** without contacting the same. As shown in FIG. **5**, the noncontact thermistor **85** is supported, at a position facing an upper face of the heat roller **81**, by the fixing unit frame **83** through an L-shaped bracket BL.

A vertical piece of the L-shaped bracket BL is fixed to a portion of the upper frame **86** (FIG. **4**) with a screw S, and the noncontact thermistor **85** is supported by a horizontal piece of the L-shaped bracket BL with a screw S. The cover portion **89**, which is attached to a central portion of the fixing unit frame **83** in the width direction, covers an upper portion of the noncontact thermistor **85**. The noncontact thermistor **85** is interposed between the cover portion **89** and the heat roller **81**.

As shown in FIG. **4**, the upper frame **86**, which is a part of the fixing unit frame **83**, covers the upper and front portions of the heat roller **81**. The upper frame **83** extends on each side of the cover portion **89** along the width direction (left-right direction) of the fixing unit frame **83**. The plate-shaped upper sheet guide **87** extends frontward from the front end of the upper frame **86**.

The upper sheet guide **87** guides the recording sheet P in the conveying direction from an upstream (front) side thereof to a downstream (rear) side thereof. The upper sheet guide **87** extends in a width direction which is perpendicular to the conveying direction of the recording sheet P and to the vertical (up-down) direction, and is disposed frontward of the heat roller **81** and the pressure roller **82**. The upper sheet guide **87** protrudes further frontward than a front end of the lower sheet guide **88**.

The front end of the upper sheet guide **87** is adjacent to the photosensitive cartridge **51** which constitutes a lower portion

of the process cartridge **50**. The upper sheet guide **87** includes a reinforcing rib **87**A which protrudes upward and extends in the width direction. The reinforcing rib **87**A is adjacent and opposite to a wall portion **96**A which extends downward from an inner face of the upper cover **96**. The upper cover **96** covers the upper frame **86** and the cover portion **89** of the fixing unit **80**. As shown in FIG. **3**, the upper sheet guide **87** includes guide slopes **87**B, **87**B formed on a lower face and at opposite end portions in the width direction so as to guide opposite corners in the width direction of the recording sheet P.

As shown in FIGS. **4** and **5**, the lower sheet guide **88** is disposed below the upper sheet guide **87** so as to face the upper sheet guide **87**. The lower sheet guide **88** comprises a front portion of a first sheet guide **88**A and a second sheet guide **88**B. The second sheet guide **88**B is disposed behind and extends from the front portion of the first sheet guide **88**A.

A recess **88**C is formed by the front portion of the first sheet guide **88**A and a front end portion of the second sheet guide **88**B so as to receive a curved portion of the recording sheet P. The second sheet guide **88**B includes a inclined guide portion **88**D which extends diagonally upward and rearward from the recess **88**C so as to guide the recording sheet P toward a nip portion between the heat roller **81** and the pressure roller **82**.

<Advantages of Fixing Unit>

In the color printer **1** as an image forming apparatus according to the above-described embodiment, the cover portion **89** of the fixing unit **80** covers the upper portion of the noncontact thermistor **85**, and the upper frame **86** of the fixing unit **80** covers the upper and front portions of the heat roller **81**. Furthermore, the upper sheet guide **87** extends frontward from the front end of the upper frame **86**. Such a structure suppresses air flow in an air layer between the heat roller **81** and the noncontact thermistor **85** when the exhaust fan **84** operates and generates air flow to cool the right end portion of the heat roller **81**. Accordingly, the noncontact thermistor **85** is allowed to detect the temperature of the heat roller **81** stably.

The exhaust fan **84** for cooling the heat roller **81** is single in number and is disposed on the right end portion of the heat roller **81** in the axial direction and below and slightly rearward of the heat roller **82**. In addition, the upper sheet guide **87** disposed frontward of the heat roller **81** is below the axis of the heat roller **81**, which is below the noncontact thermistor **85**, and above the exhaust fan **84**. The upper sheet guide **87** reduces air flow in the vicinity of the noncontact thermistor **85** during operation of the exhaust fan **84**. Accordingly, the noncontact thermistor **85** is allowed to detect the temperature of the heat roller **81** stably.

The upper sheet guide **87** extends from the upper frame **86** toward an upstream side in the conveying direction of the recording sheet P, and the lower sheet guide **88** is disposed below the upper sheet guide **87** to face the upper sheet guide **87**. Thus, the upper sheet guide **87** and the lower sheet guide **88** guide the recording sheet P smoothly toward the heat roller **81** and the pressure roller **82**.

At this time, the inclined guide portion **88**D behind the lower sheet guide **88** conveys the recording sheet P smoothly toward the nip portion between the heat roller **81** and the pressure roller **82**. Even when the recording sheet P curls relative to the width direction, the guide slopes **87**B, **87**B formed on the lower face of the upper sheet guide **87** guide the opposite corners of the recording sheet P in the width direction to help smooth conveyance of the recording sheet P.

Particularly, the upper sheet guide **87** protrudes further frontward than the front portion **88**A of the lower sheet guide **88**. This further suppresses air flow in the air layer between the heat roller **81** and the noncontact thermistor **85** and allows the noncontact thermistor **85** to detect the temperature of the heat roller **81** more stably. In addition, the upper sheet guide **87** which protrudes frontward guides an upper side of the recording sheet P, even when it curls relative to the width direction, and helps smooth conveyance of the recording sheet P toward the heat roller **81** and the pressure roller **82**.

The speed at which the recording sheet P is conveyed by the transfer unit **70** toward the fixing unit **80** is usually set slightly higher than the speed at which the recording sheet P is conveyed from the fixing unit **80** toward the sheet discharge unit **90**. Thus, the recording sheet P conveyed by the transfer unit **70** toward the fixing unit **80** is likely to sag downward. To cope with this, the recess **88**C is formed between the front portion **88**A of the lower sheet guide **88** and the inclined guide portion **88**D. The recess **88**C receives the recording sheet P while allowing the sheet P to sag, thereby to prevent jamming of the sheet P between the heat roller **81** and the pressure roller **82**.

The upper sheet guide **87** includes the reinforcing rib **87**A which protrudes upward and extends in the width direction. The reinforcing rib **87**A prevents the upper sheet guide **87** from warping in the up-down direction. Thus, the recording sheet P is smoothly guided into a clearance, which is maintained unchanged, between the upper sheet guide **87** and the lower sheet guide **88**.

The reinforcing rib **87**A is adjacent and opposite to the wall portion **96**A which extends downward from the inner face of the upper cover **96**. This further suppresses air flow toward the heat roller **81** which may be generated by the operation of the exhaust fan **84**. In addition, as shown in FIG. **1**, the front end of the upper sheet guide **87** is adjacent to the photosensitive cartridge **61**. This suppresses air from flowing between the photosensitive cartridge **51** and the upper sheet guide **87** toward the inside of the fixing unit frame **83** where the heat roller **81** is disposed. Consequently, turbulence of the air layer between the heat roller **81** and the noncontact thermistor **85** is further suppressed.

In the color printer **1** as an image forming apparatus according to an embodiment of the invention, the noncontact thermistor **85** as a noncontact temperature sensor is allowed to stably detect the surface temperature of the heat roller **81** as a heating member because air flow in the air layer between the heat roller **81** and the noncontact thermistor **85** is suppressed.

Although, in the above-described embodiment, the image forming unit **30** of the color printer **1** comprises the four process cartridges **50** and the transfer unit **70** for the four process cartridges, an image forming unit may comprise only a single process cartridge and a single transfer unit for the process cartridge.

Alternatively to the fixing unit **80**, a fixing unit may comprise a heat roller, a fixing roller, and an endless belt winding around the heat roller and the fixing roller, or may comprise a film type heating rotary body around which an endless fixing film is rotated. A pressure member to be pressed against the heating rotary body may not necessarily be a rotatable roller and may be a plate-shaped member.

Although, in the above-described embodiment, the recording sheet P, such as thick paper, thin paper, and a postcard, is taken as an example of a recording sheet, a recording sheet may be an overhead projector (OHP) sheet.

Alternatively to the color printer **1**, an image forming apparatus may be a monochrome printer, a copier, a multi-function device, etc.

While the invention has been described in connection with embodiments of the invention, it will be understood by those skilled in the art that variations and modifications of the embodiments described above may be made without depart-

ing from the scope of the invention. Other embodiments will be apparent to those skilled in the art from a consideration of the specification or practice of the invention disclosed herein. It is intended that the specification and the described examples are considered merely as exemplary of the invention, with the true scope of the invention being defined by the following claims.

What is claimed is:

1. An image forming apparatus comprising:

a heating member configured to heat a recording sheet;

a pressuring member disposed below the heating member and configured to press the recording sheet against the heating member;

a fixing unit frame supporting the heating member and the pressuring member;

an upper frame covering an upper portion of the heating member and an upstream portion of the heating member in a conveying direction of the recording sheet, the upper frame defining an air trap for trapping air heated by the heating member;

a noncontact temperature sensor disposed in the air trap and facing the heating member, the noncontact temperature sensor being configured to detect a temperature of the heating member without contacting the heating member;

an upper sheet guide which has a plate shape, wherein the upper sheet guide protrudes from an upstream end, in the conveying direction, of the upper frame in an upstream direction opposite to the conveying direction, and extends in a width direction perpendicular to the conveying direction and to a vertical direction;

a lower sheet guide disposed below and facing the upper sheet guide, the upper sheet guide and the lower sheet guide being configured to guide the recording sheet in the conveying direction toward the heating member and the pressuring member,

a sheet discharge unit disposed downstream of the heating member in the conveying direction and configured to discharge the recording sheet heated by the heating member along a sheet discharge path; and

an exhaust fan disposed below the heating member and at an end of the heating member in the width direction, the exhaust fan and the upper frame being configured such that the exhaust fan exhausts air out of the image forming apparatus along the sheet discharge path while the air heated by the heating member remains trapped in the air trap where the noncontact temperature sensor is disposed.

2. The image forming apparatus according to claim **1**, wherein the upper sheet guide protrudes further in the upstream direction than the lower sheet guide.

3. The image forming apparatus according to claim **1**, wherein the lower sheet guide comprises:

a recess configured to receive a sag of the recording sheet, and

an inclined guide extending downstream in the conveying direction and diagonally upward from the recess, and configured to guide the recording sheet into a position between the heating member and the pressuring member.

4. The image forming apparatus according to claim **1**, wherein the upper sheet guide comprises a reinforcing rib extending along the width direction and protruding upward.

5. The image forming apparatus according to claim **4**, further comprising an upper cover covering the upper frame and including a wall portion extending downward to be adjacent and opposite to the reinforcing rib of the upper sheet guide.

6. The image forming apparatus according to claim **1**, wherein the heating member comprises a roller, and the upper sheet guide is disposed below a rotational axis of the roller.

7. The image forming apparatus according to claim **1**, wherein the upper sheet guide is disposed below the noncontact temperature sensor and above the exhaust fan.

8. The image forming apparatus according to claim **1**, further comprising a process cartridge including an image bearing member and removably disposed such that a downstream end of the process cartridge is adjacent to an upstream end of the upper sheet guide in the conveying direction.

9. The image forming apparatus according to claim **1**, wherein the upper sheet guide comprises a pair of guide slopes formed at opposite end portions of a lower face thereof in the width direction and configured to guide opposite corners of the recording sheet in the width direction.

10. The image forming apparatus according to claim **1**, wherein the noncontact temperature sensor is disposed at a central portion of the fixing unit frame in the width direction.

11. The image forming apparatus according to claim **10**, wherein the upper frame comprises:

a center segment disposed facing the noncontact temperature sensor such that the noncontact temperature sensor is interposed between the center segment and the heating member in the vertical direction, and

a side segment disposed on each side of the center segment in the width direction and extending along the width direction.

12. The image forming apparatus according to claim **5**, wherein the upper cover defines a part of a discharge path along which the recording sheet conveyed between the heating member and the pressuring member is discharged out of the image forming apparatus.

13. The image forming apparatus according to claim **1**, wherein the upper sheet guide includes a fixed end connected to the upper frame and a free end opposite to the fixed end, and

wherein the free end of the upper sheet guide extends toward a process cartridge receiving portion of the image forming apparatus in the upstream direction.

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